

# First Zoeas of *Alpheus albatrossae* (Decapoda: Caridea: Alpheidae) Hatched in the Laboratory

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## ABSTRACT

First zoeas of *Alpheus albatrossae* (Banner, 1953) are described and illustrated for the first time, based on laboratory-hatched zoeas from a female collected in Ulleung-do Island, eastern Korea. The first zoeas of *A. albatrossae* can be distinguished from those of seven known species of *Alpheus* (*A. brevicristatus*, *A. digitalis*, *A. heeia*, *A. japonicus*, *A. lobidens*, *A. richardsoni*, and *A. sudara*) from Korea by having 6-segmented scale of the antenna and the endopod of the first maxilliped with four terminal setae.

**Key words:** First zoeas, *A. albatrossae*, Alpheidae, Korea

## INTRODUCTION

*Alpheus albatrossae* (Banner, 1953) has been reported from Korea, Japan, East China Sea, Bonin Islands, and Hawaii; it is known to inhabit in shallow waters down to 187 m in depth (Banner, 1953; Miya, 1974; Koo and Kim, 2005a).

Twenty-three species of the Alpheidae, represented by seven genera have been known from Korea (Koo and Kim, 2005b). Of these, with the larval description of *A. albatrossae*, larvae are described for 14 species (about 60.8%) which are assigned to four genera *Alpheus*, *Athanas*, *Automate*, and *Synalpheus* (Table 1). Three species of the other three genera *Betaeus*, *Salmonaeus*, and *Stenolpheops* as well as six species of the genus *Alpheus* are still waiting for larval study (Table 1).

The present paper is to describe and illustrate in detail the first zoeal stage of *A. albatrossae* for the first time and to compare morphological characteristics of it with those of seven species of *Alpheus* for which larvae are known from Korea.

## MATERIALS AND METHODS

On 21 June 2006, an ovigerous female of *Alpheus albatrossae* was collected by SCUBA diving in Jukdo, Ulleung-do Island, eastern Korea. Ovigerous female was maintained in 2 L glass beaker, containing well-aerated natural seawater until hatching occurred. During the experiment, seawater temperature in the laboratory rose from 24.1°C to 25.3°C (mean 24.8°C). On 29 June 2006, the female released more

than 60 first zoeas. Newly hatched zoeas were preserved in 5% neutral formalin, and dissected in lactophenol. Dissected appendages were examined by using an Olympus BX60 microscope. Drawings were made with the aid of a *camera lucida*. Measurements and setal counts were based on ten specimens. The chromatophore pattern was determined by observing living zoeas. Body length (BL) was determined from the postorbital margin to the posteromedian margin of the telson, excluding posterior setae. Carapace length (CL) was determined from the postorbital margin to the posteromedian margin of the carapace. The setal armature of the appendages is described from proximal segment towards distal segment. The specimens of the female and its first zoeas were deposited in the Invertebrate Resources Bank of Korea (IRBK), Seoul National University, Korea, under accession numbers IRBKAR003494 and IRBKAR003495, respectively.

## RESULTS

### *Alpheus albatrossae* (Banner, 1953)

First zoea (Figs. 1, 2)

BL, 2.34 (2.34-2.36) mm; CL, 0.47 (0.46-0.48) mm.

Carapace (Fig. 1A, B). Rostrum absent; anterior dorso-median papilla present; pterygostomial spine present; supraorbital and antennal spines absent; anteroventral and posteroventral denticles absent; eyes sessile.

Antennule (Fig. 1C). Peduncle unsegmented; inner flagellum with long plumose seta; outer flagellum with 4 aesthetascs and short plumose seta.

Antenna (Fig. 1D). Peduncle with spine; endopod rod-like, about 0.48 of scale, with long terminal plumose seta and spine; scale 6-segmented, with 5 distal segments, 11

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**Table 1.** Larval descriptions and known species of the family Alpheidae from Korea

Known species	Larval descriptions	Remarks
<i>Alpheus albatrossae</i> (Banner, 1953)	Present study	
<i>Alpheus bisincisus</i> De Haan, 1849	Absent	
<i>Alpheus brevicristatus</i> De Haan, 1840	Miyazaki (1937); Yang and Kim (1998)	described also from Japanese waters
<i>Alpheus digitalis</i> De Haan, 1850	Yang and Kim (2002)	
<i>Alpheus heeia</i> Banner and Banner, 1974	Yang and Kim (1999)	
<i>Alpheus hoplocheles</i> Coutière, 1897	Absent	
<i>Alpheus japonicus</i> Miers, 1879	Yang and Kim (2002)	
<i>Alpheus lobidens</i> De Haan, 1850	Yang et al. (2003)	
<i>Alpheus malabaricus</i> (Fabricius, 1775)	Absent	
<i>Alpheus pacificus</i> Dana, 1852	Gurney (1938); Gohar and Al-Kholy (1957)	described from Great Barrier Reef and the Red Sea
<i>Alpheus paracrinitus</i> Miers, 1881	Absent	
<i>Alpheus paralcione</i> Coutière, 1905	Absent	
<i>Alpheus richardsoni</i> Yaldwyn, 1971	Yang and Kim (1996) (as <i>Alpheus euphrosyne richardsoni</i> )	
<i>Alpheus spongiarum</i> Coutière, 1897	Absent	
<i>Alpheus sudara</i> Banner and Banner, 1966	Yang et al. (2003)	
<i>Athanas japonicus</i> Kubo, 1936	Yang (2003)	
<i>Athanas parvus</i> De Man, 1910	Yang and Kim (2003)	
<i>Automate dolichognatha</i> (De Man, 1888)	Bhuti et al. (1977)	described from Indian waters
<i>Betaeus granulimanus</i> Yokoya, 1927	Absent	
<i>Salmoneus gracilipes</i> Miya, 1972	Absent	
<i>Stenolpheops anacanthus</i> Miya, 1997 (as <i>Chelomalpheus koreanus</i> )	Absent	
<i>Synalpheus neomeris</i> (De Man, 1897)	Gurney (1927) (as <i>Synalpheus goodei</i> )	described from the Gulf of Suez
<i>Synalpheus tumidomanus</i> (Paulson, 1875)	Bhuti et al. (1977)	described from Indian waters

plumose setae, and distolateral spine.

Mandibles. Rudimentary; palps absent.

Maxillule (Fig. 1E). Coxal endite with 3 terminal setae; basal endite with 2 stout spines and short terminal plumose seta; endopod segmented, with terminal seta.

Maxilla (Fig. 2A). Coxal endite with 3 setae; basal endite bilobed, with 3+4 setae; endopod with 3 (1 basal+2 terminal) setae; scaphognathite with 5 plumose setae.

First maxilliped (Fig. 2B). Coxa unarmed; basis with 4 spiniform setae and 2 setae; endopod about 0.32 of exopod, unsegmented, with basal seta, subterminal seta, and 4 terminal setae; exopod with 4 terminal plumose natatory setae symmetrically disposed in 2 pairs.

Second maxilliped (Fig. 2C). Coxa unarmed; basis with 2 spiniform setae and seta; endopod 4-segmented, with 1, 0, 1, 2+1 setae, dactylus present; exopod with subterminal seta and 4 terminal plumose natatory setae symmetrically disposed in 2 pairs.

Third maxilliped (Fig. 2D). Coxa unarmed; basis with simple seta; endopod longer than exopod, 2-segmented, with 2, 2 setae, dactylus present; exopod with 2 subterminal

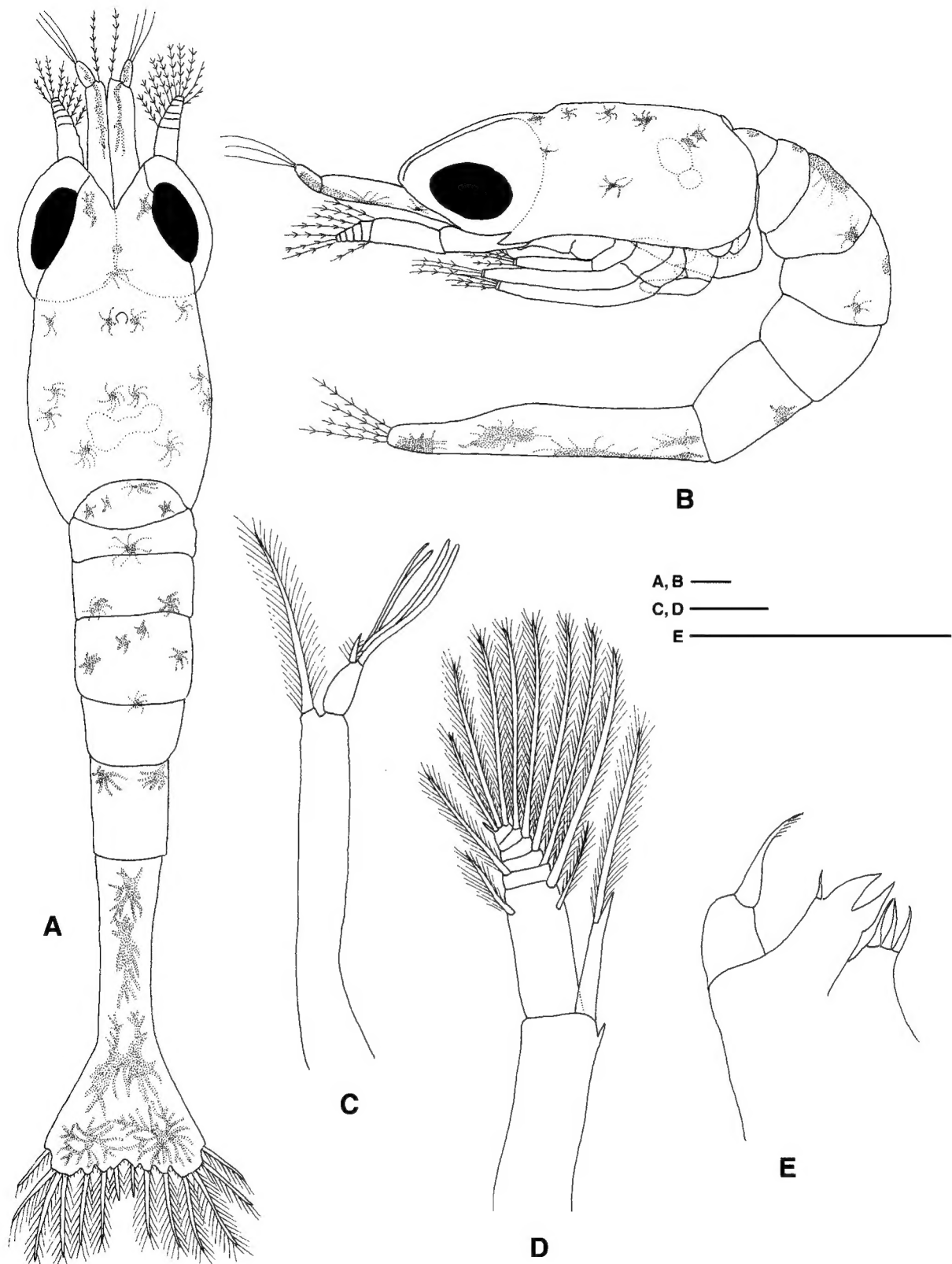
setae and 4 terminal plumose natatory setae symmetrically disposed in 2 pairs.

Pereopods (Fig. 1B). First pereopod present as biramous bud; second, third, and fifth pereopods present as uniramous bud. Fourth pereopod absent.

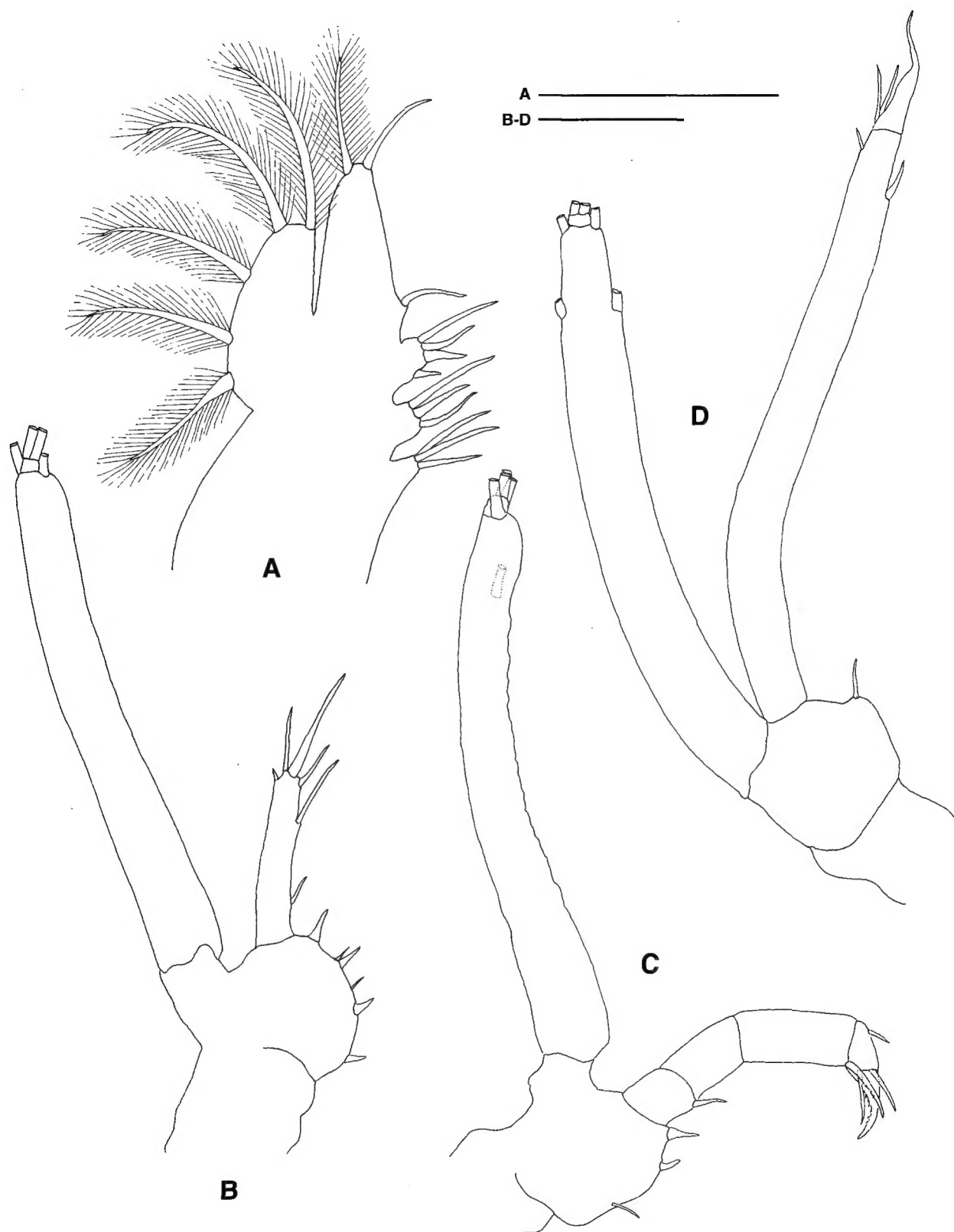
Abdomen (Fig. 1A, B). Composed of 5 somites; sixth abdominal somite not differentiated; all somites without spines; pleopods absent.

Telson and uropods (Fig. 1A). Triangular with shallow posteromedian concavity; posterior margin with 7+7 plumose setae; outermost 2 pairs plumose only on inner side; base of all setae except outermost with row of minute spinules; uropods absent.

Chromatophores (Fig. 1A, B). Red chromatophores present on superolateral margin of each eye, carapace, junction of thorax and abdominal somites, dorsally on first to third, fifth, and last abdominal somites, dorsally on telson, and laterally on second, third, and fifth abdominal somites. Yellow chromatophores present on peduncle of antenna, laterally on fifth and last abdominal somites, and ventrally on first to fifth and last abdominal somites. Interspersion of



**Fig. 1.** First zoeas of *Alpheus albatrossae* (Banner, 1953). A, habitus, dorsal view; B, habitus, lateral view; C, antennule; D, antenna; E, maxillule. Scale bars=0.1 mm (A-E).



**Fig. 2.** First zoeas of *Alpheus albatrossae* (Banner, 1953). A, maxilla; B, first maxilliped; C, second maxilliped; D, third maxilliped. Natatory setae on exopod shown truncated in B-D. Scale bars=0.1 mm (A-D).

yellow among red chromatophores present on peduncle and outer flagellum of antennule.

## DISCUSSION

Yang (2003) summarized the morphological characteristics of the larvae of the family Alpheidae as follows: carapace usually with anterior dorsomedian papilla, without anteroventral or posteroventral denticles; all abdominal somites without spines in first zoeas; scale of antenna distally segmented in first zoeas; base of maxillule without outer seta and outer lobule, endopod of maxillule segmented; maxilla usually with three endites; endopod of first maxilliped never 4-segmented, short, not more than half length of exopod; exopods of maxillipeds with four terminal natatory setae, symmetrically disposed in two pairs; and dactylus of fifth pereopod styliform, extending beyond eyes from third zoeas onward. One of these, the last characteristic can be applied from the third zoeal stage. The first zoeas of *Alpheus albatrossae* readily fit into Yang's (2003) scheme. At this time, however, it is not possible to confirm whether the last characteristic can be applied to the larvae of *A. albatrossae* because we obtained its first zoeas only. It must be checked in the future laboratory culturing of the larvae of *A. albatrossae*.

There are seven other species of *Alpheus* from Korean waters for which larvae are known: *A. brevicristatus* De Haan, 1840, *A. digitalis* De Haan, 1850, *A. heeia* Banner and Banner, 1974, *A. japonicus* Miers, 1879, *A. lobidens* De Haan, 1850, *A. richardsoni* Yaldwyn, 1971 (as *A. euphrosyne richardsoni*), and *A. sudara* Banner and Banner, 1966 (Yang and Kim, 1996, 1998, 1999, 2002, 2003; Yang et al., 2003). The scale of the antenna in the first zoeas of *A. richardsoni* and *A. japonicus* is 5-segmented, while in the first zoeas of *A. brevicristatus*, *A. digitalis*, *A. heeia*, *A. lobidens*, and *A. sudara*, it is 6-segmented. The first zoeas of *A. albatrossae* are similar to those of *A. brevicristatus*, *A. digitalis*, *A. heeia*, *A. lobidens*, and *A. sudara* by having 6-segmented scale of the antenna. The endopod of the first maxilliped in the first zoeas of *A. brevicristatus*, *A. digitalis*, *A. heeia*, *A. lobidens*, and *A. sudara* is armed with three terminal setae, while in the first zoeas of *A. albatrossae*, it is armed with four terminal setae. Therefore, the first zoeas of *A. albatrossae* can be distinguished from those of seven known species of *Alpheus* (*A. brevicristatus*, *A. digitalis*, *A. heeia*, *A. japonicus*, *A. lobidens*, *A. richardsoni*, and *A. sudara*) from Korea by the segmentation of the scale of the antenna and the number of the terminal setae on the endopod of the first maxilliped.

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